

APPLICATION  
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TITLE: PROTECTION AGAINST UNINTENTIONAL FILE  
CHANGING

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## PROTECTION AGAINST UNINTENTIONAL FILE CHANGING

### Cross Reference To Related Applications

This application claims the benefit of the U.S.

5 Provisional Application No. 60/219,919, filed on July 19, 2000.

### BACKGROUND

Files in a personal computer or other computer are  
10 often changed without the user's consent. Many of these changes, in fact, are not desired by the user.

A first set of such undesired changes may include viruses and other similar programs which can infect a user's computer and make changes to the user's computer.

15 These changes can be in many different forms. A destructive virus, for example, may delete files from a computer, either all files or just some of the files. Less destructive viruses may do less intrusive things. Some viruses change file associations.

20 Like a virus, many application installation programs may also change file associations. This is especially prevalent in music playing programs such as MP3 players. Each file that is installed and is capable of playing a

program may change the association. The user is often not given a choice.

Privacy can be compromised through hiding files on the user's personal computer. For example, one of the original  
5 types of viruses was the Trojan virus in which a file is stored on the personal computer. That file may cause the personal computer to do certain things, such as acquire information about what the user is doing. Trojans are often simply used for annoyance. However, snooper programs  
10 or Spyware programs; may be even more prevalent; these programs may be actuated on the computer by either another program, or by some party claiming to have authority.

For example, an employer may place a snooper program to watch what an employee does during working hours. A  
15 spouse may place a snooper program that watches what the other spouse does on the computer when the spouse is not around. Finally, certain programs such as GetRight™ and the like may place snooper programs (often called "AdWare") that monitor the user's actions, and report back for  
20 demographic purposes.

These programs are often very sneaky. They find and monitor information about what the user is doing, and store it in a special file on the computer. The monitoring object, e.g., a person, can either obtain that file over

the network, or can actually sit down at the computer and obtain the file.

It is very difficult to guard against such a privacy violation. A user who has intimate knowledge of computer  
5 workings may be able to guard against such an intrusion. However, the makers of such programs often stay a step ahead of any way of guarding against them.

#### SUMMARY

10 The present application teaches a system of protecting files on a computer against unintended changes.

According to one aspect, files and file types are grouped according to the functions they play in the computer. Groupings may include system files, i.e., those  
15 files which operate the operating system and the like, pointing files, which are changed during operation of the computer to indicate something that is currently occurring in the computer, and data files which represents the individual data that a user stores. These files can be  
20 protected against unintended changes.

Another aspect uses multiple criteria to decide how to continue if a questionable operation has occurred. The multiple criteria can be scored and tallied to allow an automated, but informed decision to be made, instead of

relying on chance and/or the user's possibly limited knowledge.

Yet another aspect defines a system of monitoring access to files. Certain files are protected in specified  
5 ways in order to prevent certain information about the computer from being obtained.

In an embodiment, the system protects a file domain. Files that are within the domain are handled in a way which prevents them from being read without a specified password.

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#### BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects will now be described in detail with reference to the accompanying drawings, wherein:

15

Figure 1 shows a diagram of a first embodiment which segregates files based on their function;

Figure 2 shows a flowchart of operation;

Figure 3 shows a block diagram of a computer that is usable with this system;

20

Figure 4 shows a flowchart of operation of a file domain which protects files against unintentional use;

Figure 5 shows a flowchart of file domain management; and

Figure 6 shows a flowchart of detecting a specific kind of breach.

#### Detailed Description

5        An embodiment is shown in Figure 1. This embodiment shows a block diagram of different operative parts of a computer. In the figure 1 embodiment, a hardware control system enables control over changing of files.

10        The file storage is shown as 100. This includes a file storage medium which can be any kind of storage unit, e.g., a hard disk drive or redundant array of independent disks (RAID) drive. Each of the files is stored in a different section. This section can be determined physically, i.e., by specialized areas on the disk, e.g. in  
15        different partitions. Alternatively, the areas can be delineated simply by an identifier associated with the file.

20        As shown, the files are separated into three different kinds of files. A first is the system files 101. These are the files that actually run the computer as part of the operating system. The operating system writes these files, and the files thereafter can only be changed by operating system updates. These files are given an appropriate level of protection, such that only operating system updates can

change the files, and other updates cannot change the files. These files are shown as being static system files in the sense that only these operating system updates can change them.

5       The files shown as 102 are dynamic system files.

These are system files that are associated with the operating system, but can be changed by operations which occur. Examples of these dynamic system files are the windows registry, documents list, and file associations.

10      These files can be, and in fact are, changed by installation and operation of programs. Accordingly, these files are handled in a different way.

15       Finally, data files are shown as 105. These files are user specific files, and are typically changed by the user only. The user may select delete or change these files at any time.

20       The processing part of the computer includes a driver 110 which controls the file storage 100. The processing part also includes a processor, 125 and user interface, both of which are controlled by a "chipset" 120, which is a controller of associated functions. Chipset 120 also controls the driver. The chipset provides a data bus 135 connected to the user interface module 140. In this embodiment, the user interface module 140 produces a

special secure line 142 to a special portion 145 on the  
chipset. This portion 145 is called a detect external  
actuation portion. The user interface 145 also connects to  
the display 150, receives user input 152 and may carry out  
5 other functions also.

The secure line 142 can use commercially available  
techniques, such as a hidden line that is covered with an  
epoxy ridge, and can also use encryption techniques to  
avoid spoofing. Basically, the secure line indicates that  
10 the user has made some actuation on the user interface. It  
may also indicate something about the actuation. For  
example, on a Windows(TM) keyboard, a secure line may  
indicate that the user has pressed the windows key. It may  
also indicate an enter actuation. In operation, this can  
15 allow the system to ask the user for their acceptance prior  
to producing any desired operation. The user's acceptance  
can be detected over the secure line, thereby preventing a  
computer program of some sort from spoofing the system.

The different files can be controlled in different  
20 ways.

A first mode protects the system files 101 against  
change by anything other than operating system ("OS")  
updates. The OS updates may be signed with a digital  
certificate. In addition, when the operating system is



first installed, specified criteria for the digital certificate, such as which manufacturer is allowed to make such a digital certificate, is established. The operating system update is allowed to proceed only if the digital  
5 certificate matches the prestored criteria.

In addition, a prompt can be produced, for example, "An operating system update is about to occur. Please signify that you agree by pressing the "Windows" key." Of course, any other key can be selected, but the key which is  
10 selected is preferably one which is used only for control and not used during normal entry of data. Depression of the selected key produces a signal on the secured line 142, which is detected by the chipset 120. Hence, operating system updates are only allowed if (1) the digital  
15 certificate encryption on the operating system matches a specified characteristic, meaning the sender is a recognized sender, and (2) the user signifies their intent to proceed.

As an additional layer of protection, an internet  
20 checking system can be used. For example, if the digital certificate becomes compromised, then others might be able to produce viruses which mimicked the digital certificate. Accordingly, another system, adding an additional layer of protection, checks on the internet to see if the operating

system update/digital certificate should still be accepted,  
or if there are known compromises to the certificate. When  
the check via Internet option is selected, e.g., by  
checking the button, the system checks a secured database  
5 of information, e.g., one stored by a trusted source, to  
determine if the update is authorized.

The chipset includes either microcode or hard wired  
logic that executes the specified operation. In this  
operation, the driver will produce new commands to override  
10 the static system files only when the specified criteria  
are met. While the above has described both a user  
actuation and encryption being used, it should be  
understood that any subset of the above could also be used.

Dynamic system files are changed during operation.

15 For example, the Windows "document list" is frequently  
changed i.e. whenever a program is started. The Windows  
registry, however, may be less frequently and more simply  
used. Different files within this structure have different  
characteristics and hence different levels of protection.

20 For example, the registry may require protection with  
encryption or with a manual override. In contrast, dynamic  
files whose content really does not effect the operation of  
the operating system, such as the "My Documents" directory,  
may require no security. The different kinds of files may

be set in advance with different preferences for the file.  
For example, different preferences may be set.

A common problem is file associations. Many times  
programs war over which program opens which file. A

5 typical scenario for file associations is shown in Figure  
2. When a program is installed, it carries out various  
operations. At step 200, it attempts to make a file  
association. This causes a note to be displayed  
indicating, "an installation program is trying to  
10 change/add a file association." Additional information  
shown in 202 indicates that the file is/is not already  
associated. If the file is associated, the additional  
information shown as 204 is displayed indicating that using  
the file will change the following association. At 206,  
15 the user is given an option of whether they want to allow  
it. The alternatives are yes, no, and give recommendations  
at 208. The recommendations at 208 carry out a number of  
different tests to determine what the proper recommendation  
should be. At test 210, the system is tested. In this  
20 embodiment, manufacturers who have already-installed  
programs are given higher scores than those who do not.  
For example, a computer system can have 15 programs  
installed by Microsoft, and three by Adobe, and one by some  
secondary manufacturers. A program that came from Adobe,

in this example, would have a lower priority than one of  
Microsoft. However, both of these would have higher  
priorities than some third-party vendor. The system  
therefore scores the number of vendors who each have a  
5 specified program. Those vendors with a specified program  
are then given higher priority. In addition, the user is  
able to override these priorities, and set preferred  
vendors. For example, the user may have a preferred vendor  
e.g., a Linux vendor. In that case, the system may also  
10 have the capability of allowing a user to set specified  
preferred vendors.

At 215, the system searches for information that is  
pre-stored for specific file associations. For example, a  
file may have a pre-stored preferred file association. An  
15 example is that Microsoft Word may be pre-associated with  
documents of the .doc type. However, other programs, such  
as Microsoft Works and others may also be able to use this  
type, but would be preempted by a later program that is  
actually the preferred format. At step 220, the system  
20 consults an Internet database. Different Internet  
databases can be used. For example, third party companies  
such as Symantec may maintain databases of trusted sites.  
Different websites may also have databases indicating which  
among a number of different companies is the best site for

a specified file format. The user can then select one of those companies as their preferred database. When a problem occurs, the system consults the database to determine which of the multiple programs is recommended for  
5 use.

At 225, the system determines if the program being installed has the requested program as its native file format. For example, some programs may be capable of playing a number of different formats such as the Real  
10 player which is capable of playing the Real format as well as many other sound formats. However, the Real player's native format is in fact the "Real" format. It scores high on that association; less high on the MP3 association.

At 230, certificates and authorities can also be  
15 checked. The certificates indicate whether the system has an authorized certificate or not. The authorities, similarly, can be used to determine whether the system is from an authorized authority. Another test is made at 235 to determine the way the current program is behaving. For  
20 example, the number of crashes of the current program is determined.

At step 240, the system determines if the operation is associated with new hardware which is currently being installed. If so, then the installation is automatically

allowed to continue, unless overridden for example. Or,  
the recommendation is to proceed.

Any of these systems can also be used with any of the  
other unwanted file writing protection systems.

5        Each of these options produces a scoring. A tally of  
all the scores is accumulated. The tally can be used to  
make a recommendation, or to automatically select an  
option.

10        Alternatively, some tests may be binding, and passing  
that test causes an automatic association.

15        Figure 3 shows a block diagram of a basic computer  
system of the type contemplated according to the present  
invention. The computer system includes a monitor 300,  
coupled to a computer system 310 which is driven by  
commands from a user interface 320. The computer system  
310 runs an operating system 312 which includes an  
additional layer 314 shown as a file domain layer (FD).  
The file domain layer can be part of the operating system,  
can run under the operating system, or can run over the  
20        operating system, e.g., as a layer that is loaded prior to  
the operating system loading. The operating system, as  
conventional, controls file access. Therefore, the  
operating system controls access of the computer 310 to the  
hard drive 330, and to a removable media 335 which can be a

floppy disk, a CD, or any other removable media. Other nonvolatile memory accesses can also be used.

In operation, the process follows the operation of Figure 4. The user logs in to the computer at 400 in order  
5 to obtain access to parts of the computer such as the file system. As part of the login, the user must enter a unique code, e.g., a password or biometric, or smartcard, or digital certificate, or other similar item. If a password is used, the password is preferably known only to the user,  
10 and allows the user access to the files. The term password can be thought of as generic to any private information available only to a user. This can include, for example, a personal identification number, an actual password, biometric information, or other personal identifying  
15 information. If biometric information is used, the biometric information can be converted into encryption data, using the techniques described in application number 09/577,449.

Once the user has logged into the computer, the  
20 operating system controls access of the user to various files on the computer at 405. The operating system controls this access in combination with the file domain layer 314.

Any time that access to a file on the computer is desired, the process operates using the file domain to control the way that access to the files is allowed.

Different file accesses are conventionally controlled  
5 by the operating system. For example, a windows system might access FAT and FAT32 files on a first drive, and NTFS files on a second drive, or on a partition of the same drive. This system basically defines another kind of files on a drive. The file domain reads and writes files to the  
10 disk, to a partition of the disk, or to just a portion of the disk, using an encryption layer which is described herein. The encryption layer encrypts/decrypts all of the file reads and writes which occur in a certain way, using the unique code. In one embodiment described herein,  
15 encryption of all files, except those which qualify for an exception to the encryption, is carried out. The encryption uses the unique code. Only one specified user has access to the unique code, and hence only that one specified user can get access to the files. The encryption  
20 of reading and writing can be overridden only by specified actions.

The specific system shown in Figure 4 allows certain file accesses to be handled in different ways. Unencrypted files can only be read by the file system,



i.e., they are read-only, at 410. The system can allow the unencrypted file to become a read/write file. When the file becomes a read write file, it may either be made part of the user's personal file domain, or a copy of the file is made part of the user's file domain. Files within the file domain are encrypted, and can only be read or written by a user who logs in with the proper unique code/password. An alternative is to change security on specified files, allowing those files to become part of the file domain even without encryption. This alternative is less secure; since it allows some files in the file domain to be unencrypted. Those files are preferably specified one by one, and only files which are specified can be handled in that way.

Special file types may be allowed to have read write unencrypted access. For example, word processing documents may be specified for this kind of access. This again provides a security hole, since it allows files to be hidden by making them look like a special file.

In the most preferable mode, however, all read/write files on the computer, which is the bulk of the files, i.e., those which are allowed to be written to by the computer, are encrypted in a special way that requires encryption using the user's password. The encryption preferably requires that the user's unique code be used.

Therefore, only the user who logs in with the proper password can read the contents of the encrypted file.

Snooper programs and spyware, and other programs which may write information to the hard drive, may be  
5 significantly limited. This system still allows the information to be written to the hard drive, but that information is encrypted in a way such that only the authorized user can read that file.

Many of the operating system files may be designated  
10 as read only. In this way, the operating system can be loaded and may run without the encryption layer being loaded. All files which are read-only can be freely read by any process and any user who logs into the computer. This allows the operating system to start. As part of the  
15 operating system's operation, of course, there are certain files that need to be read and also written to. Examples of these files include the registry, journals, and the like. Each of these files is intended to be individual to each user who logs on to the computer. Each user who logs  
20 on to the computer receives their own individual set of files. Those files are maintained encrypted, and can be read only by that user. If a new user logs on, that new user will receive their own file domain, with their own set of files with which they can interact in an encrypted way.

If a process on the computer attempts to write to an unencrypted file, that is one which is labeled by the file domain as read only, this may indicate a breach in progress. One such breach, for example, would be saving  
5 from a keyboard buffer or screen buffer. The system may respond with a warning of the type shown in 420. The warning screen indicates that the computer is attempting to write to an unsecured file. A number of options may be presented. A first option is to copy or move the file to  
10 the file domain, in which case the file and all its contents become encrypted. Yet another option is to prevent writing and log the occurrence.

Any time a snooper program surreptitiously attempts to write, the warning screen such as 420 might be shown. If  
15 the user elects to make a copy of the file to their file domain, subsequent encrypted writing to that file is also allowed. Any user who logs in as the specified user can also read and write to that file. However, any other user, including the network user and an administrator, can not  
20 read or write to that file due to the encryption.

The special files are shown in 430. These are also handled in a special way. A user may want certain files to be unencrypted so that they can be shared. The special files may be read write files which are unencrypted. In

this system, for example, a user may designate certain programs such as word processing programs to allow read write access to an unencrypted file. Using the example of Word (TM), the user may want all files which are acted on  
5 by Word to be unencrypted. This leaves, however, a potential security hole, since a snooper program can then act like word, and write all of its information to word files. Another important example is an Internet browser. The Internet browser must be able to produce files and file  
10 information that can be sent outside the system. Therefore, certain Internet files must be special unencrypted files. Accordingly, additional security measures can be taken for these special files.

430 shows these additional security measures. One or  
15 more of these security measures may be carried out for each of the special types of files. The file may only allow unencrypted access by the registered program, shown here as "registered program access". The file domain layer monitors access to the files, and only allows this access  
20 when the native program for the file type is conducting the access. Again, a sufficiently smartly-designed program can fool the OS, e.g., into detecting that word is actually accessing the program when it is not. Another aspect therefore requires the native program, e.g the Word

program, to be actually open when file access is carried out.

Another security aspect may require that the files be encrypted when stored, but may allow the user to decrypt

5 the files prior to sending them outside the system. For example, the temporary Internet files on the system may be stored encrypted. Any file that needs to be uploaded, however, may be decrypted prior to upload. Certain security measures may be carried out prior to decryption, 10 to make sure that the upload is actually one which is being initiated by the user, rather than one which is being automated to obtain access to it decryption file.

One additional security measure leaves an indicia of the file writing. For example, the system may write to a

15 log for each file write of a special type that occurs. This enables either the system or the user to later monitor that file write log to determine if some program is attempting to masquerade as the native program. The log can include information about the program that made the 20 accesses, such as program name and the like. In addition, the program is only allowed to operate when the document is placed in the edited documents list. Again, the user can therefore easily see if writing has been carried out to documents which the user has not been using.

Another aspect may allow writing within a certain time, e.g. 5 seconds after a user interface actuation. Other security measures can also be carried out. Each of these security measures is calculated to attempt to prevent  
5 a program from surreptitiously obtaining write access to a file which could later be viewed by another user.

Another form of unencrypted file write is to the removable media shown here as 335. There is much less of a security risk from writing to a removable media, since the  
10 user will not typically leave media in the removable drive long enough to cause it to be a security risk. In addition, on shutdown, the system can warn that the user should remove any removable media from the drive in order to further minimize this risk. Therefore, one other way of  
15 forming an unencrypted read/write file is to send the file to the removable media shown as 440.

A file can be made into a special file by right clicking on the file, and changing its properties to a shared file. The shared file is a special file having the  
20 characteristics of the special file shown in 430. The layer maintains file security in this embodiment, and allows each file to be separately designated as having different characteristics.

A specific kind of snooper program is described herein which may be specifically advantageous as a snooper program, and may be specifically difficult for any system, even the presently-described file domain system, to detect.

5 The snooper program is started with the operating system, using a registry key which causes the program to stay within memory. The program carries out its operations, and maintains its results in either a swap file, a page file, or in RAM. These results can be, for example, screenshots.

10 This much may be conventional in snooper programs. Any time that a program opens a native document, which may include any document of a word processing type, or even an Internet document, the snooper program detects this opening. The information in the results is then stored as  
15 part of the open document, e.g., as a hidden comment, or steganographically stored within the open document. A log file maintains information about where the results were stored.

This may fool even this system, since the information  
20 is present in documents which are opened by their native application. The log file may be stored encrypted, and may be difficult to find. However, the snooper program may still have a way of detecting which native files were access by the snooper program when desired access to the

file by an administrator is desired. Full security-that is security which encrypts all files, will defeat this system. The presence of special files, however, may make it possible for this kind of system to provide a desired  
5 information about a system.

In operation, the file domain layer may operate as part of the operating system, or associated with the operating system. The layer may be a file called by the operating system that started. Alternatively, the layer  
10 may run below the operating system, called by the system bios. In any case, the layer carries out these basic operations described herein. At 500, system uses the user password in combination with a private key which is stored on the computer plus a random number which may be a time  
15 and day stamp, plus a hardware-based key. The hardware based key may be for example a bios serial number or processor serial number for example. Each of these numbers are concatenated together to generate an encryption key. The key is used for the encryption and decryption of files.  
20 The key may be a session key which is unique since it includes information from the random number. However, the random number information is also encrypted as part of each file write, so that the corresponding random number information can be used to generate the file reading key



during the next session. The user's unique information becomes an indispensable part of the session key. The key cannot be formed without the user password, and therefore without the user password, encrypted files cannot be read or written. In addition, by using the hardware key, these encrypted files which are stored on the internal drive, cannot later be read on another computer. The hardware key may be considered as optional, and a somewhat less secure system can be used by simply getting together the user's private key and password to generate the session key. All of these techniques are well-known in cryptographic science, and are not described in detail herein.

During an initial set up of the system, the system may also generate a recovery routine. The recovery routine can be used when there is a catastrophic failure, for example a system crash, or a death or illness of the user. This may provide a backdoor entry into the encrypted file system. The user may generate the recovery routine special key, and stored on a disk in a safe location. In this way, the user can direct another to obtain access to his files without actually giving up the password.

After generating the key at 500, the user obtains access to the file domain. Again, this file domain has access to all read-only files everywhere in the system, all

of which are unencrypted. The file domain may also have restricted access to special file types as described above. In addition, the file domain has access to read write unencrypted files that are within the file domain. The  
 5 file domain also, as described above, allows certain files to be copied as encrypted read/write files into the file domain. The file system maintains a list of those files which have been copied to make them editable. Any attempt to write to one of the files which has been copied in this  
 10 way is translated into a request to write to the copy. The file domain management, shown as 310, includes all of these operations described above.

This system describes using encryption to protect against privacy intrusions and other operations which can  
 15 be carried out without the user knowing it. However, other techniques can be carried out within the computer for enhancing the security of files within a file domain.

At any time during the operation, the user may run the security routine 520 which operates to further enhance  
 20 system security. The security routine may display a list of documents which have been accessed as a read write file. This may allow the user to determine if any of these documents have been accessed by a program other than those that the user has designated.

In addition, the security routine may be updated with information about undesired programs; e.g., snoopers and Spyware. This information can describe techniques used by snoopers to store information into a file. The  
5 security routine can analyze file accesses to determine if any of them are likely to be accesses by snoopers and report on that.

While the above has described monitoring file access for prevention of snoopers, it should be understood  
10 that this monitoring the file access can also be used for other reasons. For example, many different flavors of viruses and worms may actually change the user's programs on the computer. This system makes certain files as read only, and therefore may prevent a virus from making these  
15 changes. Moreover, by encrypting the files, the virus may not be able to operate in the way that it was designed since it does not obtain native access to the files; it only obtains access to an encrypted version of the file.

In addition, the security routine at 520 can analyze  
20 file accesses, and may also be programmed with virus information to monitor the viruses.

In summary, the above embodiment may prevent a snoopers program from operating properly. Even if the snoopers programs actually does the snooping and writing, it may

carry out its writing only in encrypted form that cannot be read by someone who does not have the user password.

The system described above protects the file domain through encryption. However, it may be possible to protect the files in the file domain in other ways. For example, a firewall may be erected in the computer to protect certain files from being read. The firewall prevents files that are within the file domain from being read from outside the firewall. The user's password may be necessary to have access to the firewall. This can also protect specified files within the computer from being read externally.

Another embodiment, shown in figure 6, may also guard against snoop operations. In this embodiment, usable without the file domain encryption described above, the file domain system monitors all states and/or operations. Any states, which include saving contents of the screen buffer or keyboard buffer, are specifically monitored. In certain circumstances, such as screen shots, and printing to PDFs for example, it may be desirable to actually print from these buffers. However, other operations such as screen shots might be simply attempts to improperly obtain information. Accordingly, each time a save is carried out which is based on information in this way, a security alert may be displayed. The security alert queries, for example,

"are you really intending to save buffer contents?" If the user is for example attempting to do a screen shot, than the user will of course say yes. If not, the user may say no, and log the incident to attempt to find the program

5 later that is carrying out the save. This system may also include a security routine, and the contents of the log are used by the security routine to attempt to find additional information about the program.

Other embodiments are contemplated.